Hydrodynamics of finely structured ICF pellets

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The paper describes a novel concept of the ICF pellets containing deliberately introduced fine structures, both spherically symmetric and asymmetric. Properly chosen structures should allow one to excite rotations and shear flows in the pellet [1] and to control Rayleigh-Taylor instability during implosion [2].

Two techniques for spinning the ICF pellets up prior to or in the course of their compression are suggested: i) using of the structured pellet surfaces which would produce an East-West asymmetry in the ablation rate and thereby create an ablation torque; ii) creation of the rotating layer deep inside the pellet by using impregnations which would cause an asymmetric reflection of the radially converging compression wave. Interference of the rotational shear flow with the Rayleigh-Taylor instability is analyzed with a conclusion that, under certain circumstances, the shear flow can considerably suppress the Rayleigh-Taylor instability and thereby improve the pellet performance.

Spinning pellets can also serve for laboratory simulations of some astrophysical phenomena, like formation of Galactic discs and magnetic field generation by shear flow turbulence.

The other type of structures is that of a series of thin spherically symmetric layers of varying density. It turns out that in such a system velocity perturbation in Rayleigh-Taylor modes contains a significant and strongly non-uniform shear component which causes the increase of the viscous dissipation. We find growth rates of the Rayleigh-Taylor instability for some specific examples of these fine structures.

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[1] D.E. Baldwin, D.D. Ryutov. Comments on Plasma Physics and Controlled Fusion, v.17, p.1, 1995

[2] D.D. Ryutov. LLNL report UCRL-JC-123433, March 1996.

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